

## REMARKS

The Official Action dated October 8, 2002 has been carefully considered.

Accordingly, the changes presented herewith, taken with the following remarks, are believed sufficient to place the present application in condition for allowance. Reconsideration is respectfully requested.

By the present Amendment, claims 2-4 and 6 have been cancelled, and claims 1, 11 and 13 have been amended to include limitations from claims 3, 4 and 7. Claims 7, 14, 17 and 18 have been amended for matters of form. A Version With Markings Showing Changes Made is attached. Claims 19-28 have been added. Support for claims 19, 21 and 24 may be found in the specification at page 10, lines 4-7, support for claims 20, 23, 26 and 28 may be found in the specification at page 13, lines 12-15, and support for claims 22 and 25 may be found in original claim 5. Finally, support for claim 27 may be found in original claims 1, 5 and 7 and the specification at page 10, lines 4-7. It is believed that these changes do not involve any introduction of new matter, whereby entry is believed to be in order and is respectfully requested.

In the Official Action, claims 17 and 18 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite. The Examiner asserted that there was insufficient antecedent basis for recitation of the durability test. This rejection is traversed and reconsideration is respectfully requested. Specifically, claims 17 and 18 recite a durability test of specified temperature, voltage and time. It is therefore submitted that these claims are definite and that the rejection under 35 U.S.C. §112, second paragraph, has been overcome. Reconsideration is respectfully requested.

Claims 1, 2, 6, 11 and 13 were rejected under 35 U.S.C. §102(b) as being anticipated by the Okuyama et al U.S. Patent No. 5,956,225, with reference to the Setoyama et al publication entitled "Simulation Study on the Relationship Between a High Resolution

$\alpha_s$ -Plot and the Pore Size Distribution for Activating Carbon." Claims 4 and 5 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okuyama et al and further taken with the Kaneko et al U.S. Patent No. 5,997,613 and the Hiratsuka et al publication entitled "A Valuation of Activated Carbon Electrodes for Electric Double Layer Capacitors Using Organic Electrolyte Solution." Claims 8-10, 12 and 14-16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okuyama et al and further in view of the Hirahara et al U.S. Patent No. 6,094,338. Finally, claims 17 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okuyama et al and further in view of the Hiratsuka et al U.S. Patent No. 6,072,692.

The Examiner asserted that Okuyama et al disclose activated carbon for use in an electrode of a double layer capacitor and contain pores with a pore diameter of not less than 20 angstroms and a ratio of pore volume with a diameter of not less than 20 Angstroms (2.0 nm) to a total pore volume of greater than 0.5 and as high as 75%. The Examiner further asserted that the relationship of pore size to filling swing is known from Setoyama et al which states that pores of width higher than 1.4 nm show no or zero filling swing. The Examiner therefore concluded that the activated carbon material of Okuyama et al, having pores almost entirely above a width of 2.0 nm, has a rate of filling swing of zero and therefore less than 25 cm<sup>3</sup>/g STP. The Examiner relied on Kaneko et al as teaching that activated carbon fibers prepared from pitch have an oxygen content of about 1.0 to 1.5% by weight and on the Hiratsuka et al publication as teaching that the capacitance of a carbon electrode after voltage application for an extended time decreases more in carbon electrodes with high oxygen content. The Examiner relied on Hirahara et al as teaching activated carbon material may be formed from coconut shells, coal pitch or petroleum pitch, and polyvinylidene chloride resins, and a capacitor exhibiting a loss of capacitance of only 4.4%. Finally, the Examiner

relied on the Hiratsuka et al patent as teaching a capacitor exhibiting retention resistance of 104% and retention of capacitance of 96%.

However, as set forth in detail below, Applicants submit that the activated carbon, activated carbon electrode and electric double layer capacitor defined by claims 1, 5 and 8-18 are not anticipated by Okuyama et al, with reference to Setayama et al, and are nonobvious over and patentably distinguishable from Okuyama et al, with reference to Setayama et al, and in further combination with one or more of Kaneoko et al, the Hiratsuka et al publication, Hirahara et al and/or the Hiratsuka et al patent. Accordingly, these rejections are traversed and reconsideration is respectfully requested.

More particularly, claim 1 recites an activated carbon for electric layer capacitor, claim 11 recites an activated carbon electrode formed with an activated carbon, and claim 13 recites an electric double layer capacitor equipped with activated carbon electrodes formed with an activated carbon as polarizable electrodes. According to claims 1, 11 and 13, the activated carbon has a rate of FS (filling swing) in an  $\alpha_s$ -plot by nitrogen absorption method of 10-25 cm<sup>3</sup>/g STP, an oxygen content at the surface thereof of at most 5% as determined by X-ray photoelectron spectroscopy, and a specific surface area of 1000-2000 m<sup>2</sup>/g as determined by nitrogen absorption in accordance with the BET method. The defined activated carbon provides an electric double layer capacitor exhibiting high electrostatic capacity and low resistance. Additionally, the defined activated carbon provides an electric double layer capacitor exhibiting excellent durability in terms of both retention of electrostatic capacity and retention of resistance.

Okuyama et al disclose an activated carbon for an electric double layer capacitor. The activated carbon has a mesopore region with a pore diameter of not less than 2.0 nm (20 Angstroms). Okuyama et al describe that the micropore region contributes little to capacitor performance and is reduced to a minimum (column 2, lines 10-18). In the activated carbon

having mesopores, as well known in the art, capillary condensation swing is generally observed at above  $\alpha_s = 1$ , and the deviations (FS and CS) from the broken line below  $\alpha_s = 1$  are substantially not observed. The FS suggests empirically the presence of micropores whose width is  $< 1.0$  nm (see Setoyama et al. at page 1460, column 2 and Fig. 2). Thus, as asserted by the Examiner, the teachings of Setoyama et al demonstrate that the rate of FS of Okuyama et al activated carbon having pore diameters not less than 20 Angstroms would be at or close to zero.

In contrast, the activated carbon defined by claims 1, 11 and 13 has a rate of FS of 10 to 25 cm<sup>3</sup>/g STP and therefore is significantly distinguishable from the activated carbon of Okuyama et al having pore diameters not less than 20 Angstroms. Furthermore, Applicants find no disclosure in Okuyama et al. regarding the oxygen content at the surface of the activated carbon.

Anticipation under 35 U.S.C. §102 requires that each and every element as set forth in the claims is found, either expressly or inherently described, in a single prior art reference, *In re Robertson*, 49 U.S.P.Q.2d 1949, 1950 (Fed Cir. 1999). In view of the failure of Okuyama et al to teach an activated carbon having a rate of FS of 10 to 25 cm<sup>3</sup>/g STP, an oxygen content of at most 5% and a specific surface area of 1000 to 2000 m<sup>2</sup>/g, as defined in claims 1, 11 and 13, Okuyama et al do not set forth each and every element of the present claims, and therefore do not anticipate the present claims under 35 U.S.C. §102. It is therefore submitted that the rejection of claims 1, 11 and 13 under 35 U.S.C. §102 has been overcome. Reconsideration is respectfully requested.

Moreover, the deficiencies of Okuyama et al with Setayama et al are not resolved by the secondary or tertiary references cited by the Examiner, whereby claims 5, 8-10, 12 and 14-18 are nonobvious over and patentably distinguishable from the combinations of references cited by the Examiner.

More particularly, Kaneko et al describe pitch-based activated carbon fibers prepared from pitch having an oxygen content of about 1.5 % by weight in a conventional manner as by spinning the pitch, infusibilizing the pitch fibers and activating, with the thus obtained carbon fibers having an oxygen content of about 1.0 to 1.5% by weight (column 2, lines 32 to 38). The Hiratsuka et al publication describes that the deterioration of a coin cell type capacitor during voltage application was found to be closely related to the oxygen content of activated carbon used in the electrode (page 607 and Fig. 10). In addition, Hiratsuka et al teach that the oxygen contents of activated carbon samples are in the range of 4.3 to 25.5 (Table 3). Hirahara et al disclose electric double-layer capacitors and the formation thereof by carbonization and gas or chemical activation. Finally, the Hiratsuka et al patent discloses electric double-layer capacitors having a specific surface area of at least 500 m<sup>2</sup>/g and, in their examples, capacitance and internal resistance exhibited by exemplary capacitors before and after a cycle test.

However, Applicants find no teaching or suggestion in any of these references relating to an activated carbon, an activated carbon electrode formed with an activated carbon or an electric double layer capacitor equipped with activated carbon electrodes, wherein the activated carbon has a rate of FS in an  $\alpha_s$ -plot by nitrogen absorption method of 10-25 cm<sup>3</sup>/g STP. Thus, none of these references resolve the deficiencies of Okuyama et al. Moreover, Applicants find no teaching or suggestion in any of the references of such an activated carbon having a rate of FS as required by the present claims together with an oxygen content at the surface thereof of at most 5% as determined by X-ray photoelectron spectroscopy and a specific surface area of 1000 to 2000 m<sup>2</sup>/g as determined by nitrogen absorption in accordance with the BET method. In fact, Hiratsuka et al teach that oxygen contents of activated carbon samples are in the range of 4.3 to 25.5%, and Applicants find no teaching in any of the references relating to a surface oxygen content as claimed. Additionally, claim 5 requires

that the activated carbon has an oxygen content at the surface thereof of lower than 3%.

Applicants find no teaching in this regard.

In order to render a claimed invention obvious, the prior art must enable one skilled in the art to make and use the claimed invention, *Motorola, Inc. v. Interdigital Tech. Corp.*, 43 U.S.P.Q.2d 1481, 1489 (Fed. Cir. 1997). In view of the failure of any of the cited references to teach or suggest an activated carbon, an activated carbon electrode formed with activated carbon, or an electric double-layer capacitor equipped with activated carbon electrodes, wherein the activated carbon has a rate of FS of 10-25 cm<sup>3</sup>/g STP, particularly in combination with an oxygen content and specific surface area as required by claims 1, 11 and 13, Okuyama et al in combination with any of Kaneko et al, the Hiratsuka et al publication, Hirahara et al and/or the Hiratsuka et al patent do not enable one skilled in the art to make and use the presently claimed activated carbon, activated carbon electrode or electric double-layer capacitor. Thus, the cited combinations of references do not render the presently claimed invention obvious. It is therefore submitted that the rejections under 35 U.S.C. §103 based on Okuyama et al in combination with Kaneko et al and the Hiratsuka et al publication, in combination with Hirahara et al, and in combination with the Hiratsuka et al patent have been overcome. Reconsideration is respectfully requested.

Claims 1-3 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Shimizu Japanese Reference No. 9-162082A in view of Setoyama et al and taken with the Ohsaki et al U.S. Patent No. 5,985,489. Claim 7 was rejected under 35 U.S.C. §103(a) as being unpatentable over Shimizu and Ohsaki et al and further taken with Kaneko et al. The Examiner relied on Shimizu as disclosing the production of an electric double-layer capacitor which can suppress capacitance deterioration and on Ohsaki et al as teaching a means by which pore sizes of activated carbon may be adjusted. The Examiner again relied on Setoyama et al as disclosing filling swing and asserted it would have been obvious to apply

the process of pore size adjustment of Ohsaki et al in the material of Shimizu in order to produce activated carbon containing a pore width of a desired size primarily above 1.2 nm. The Examiner again relied on Kaneko et al for teachings regarding the production of activated carbon electrodes for use in double layer capacitors.

However, Applicants submit that the activated carbon defined by claims 1 and 7 is nonobvious over and patentably distinguishable from Shimizu in combination with Setayama et al, Ohsaki et al and Kaneko et al. Accordingly, these rejections are traversed and reconsideration is respectfully requested.

As noted above, the activated carbon of the present invention has a rate of FS of 10-25 cm<sup>3</sup>/g STP, an oxygen content at the surface thereof of at most 5%, and a specific surface area of 1000 to 2000 m<sup>2</sup>/g, as recited in claim 1.

As set forth in the English abstract, Shimizu discloses an electrode/separator laminated body 12 impregnated with an electrolyte and housed in an container 10 maintained at a negative pressure to prevent capacitance deterioration. On the other hand, Ohsaki et al disclose at column 10, lines 35 to 46, that a pore adjustment treatment may be conducted to adjust the size of the pores so that organic solvent in the electrolytic solution does not enter the pores. Further, Ohsaki et al disclose at column 16, lines 34 to 47, that pores are formed into which it is possible for lithium ions which have a small ionic diameter to pass, but into which solvent molecules which have a large molecular diameter cannot penetrate. Thus, it is apparent that Shimizu and Ohsaki et al disclose alternate means for preventing electrolyte degradation of activated carbon.

However, Applicants find no teaching or suggestion for combining the teachings of Ohsaki et al and Shimizu, or relating to any improvement provided thereby. Even in view of Setoyama et al's teachings with respect to pore width, Applicants find no motivation for combining the teachings of Shimizu and Ohsaki et al along the lines asserted by the

Examiner. In fact, as Ohsaki et al disclose a pore adjustment treatment which prevents solvent molecules having a large molecular diameter from penetrating the pores, it would not be obvious to adjust the pores of Shimizu above 1.2 nm as asserted by the Examiner.

Moreover, Applicants find no teaching or suggestion in either Shimizu or Ohsaki et al relating to an activated carbon having a rate of FS of 10 to 25 cm<sup>3</sup>/g STP as recited in claim

1. When polarizable electrodes are formed with an activated carbon having a rate of FS higher than 25 cm<sup>3</sup>/g STP, electrolytic solvent, ions and the like are strongly bound in pores, forming a strong molecular adsorption field, and the probability of oxidation and reduction of the electrode material becomes high, resulting in an electric double layer capacitor having poor durability. On the other hand, an activated carbon having a rate of FS of 10 to 25 cm<sup>3</sup>/g STP has less pores forming the strong molecule adsorption field, and so reactions with solvent, ions and the like are lessened, resulting in an electric double layer capacitor having good electrostatic capacity and low resistance, with excellent durability. Applicants find no teaching or suggestion in this regard by either Shimizu or Ohsaki et al, or in combination with Setoyama et al.

Finally, Kaneko et al do not resolve the deficiencies of Shimizu, Setoyama et al and Ohsaki et al. While, as noted above, Kaneko et al describe pitch-based activated carbon fibers and methods of preparing such fibers, Applicants find no teaching or suggestion by Kaneko et al of activated carbon having a rate of FS as required by the present claims. Similarly, Applicants find no teaching or suggestion by Kaneko et al relating to activated carbon having such a rate of FS in combination with the oxygen content and specific surface area required by claim 1.

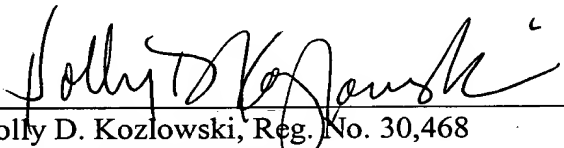
In view of the deficiencies in the teachings of Shimizu, Ohsaki et al, Setoyama et al and Kaneko et al, the cited combinations of these references do not enable one skilled in the art to make and use the presently claimed activated carbon. It is therefore submitted that the



activated carbon defined by claims 1 and 7 is nonobvious over and patentably distinguishable from Shimizu, Ohsaki et al and Setoyama, even in further view of Kaneko et al, whereby the rejections under 35 U.S.C. §103 have been overcome. Reconsideration is respectfully requested.

It is believed that the above represents a complete response to the rejections under 35 U.S.C. §§ 102, 103 and 112, second paragraph, and places the present application in condition for allowance. Reconsideration and an early allowance are requested.

Respectfully submitted,

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**VERSION WITH MARKINGS SHOWING CHANGES MADE**

**In the Claims:**

Claims 1, 7, 11, 13, 14, 17 and 18 are amended as follows:

1. (Amended) An activated carbon for electric double layer capacitor, having a [whose] rate of FS (filling swing) in an  $\alpha_s$ -plot by [the] nitrogen adsorption method [is at most 27 cm<sup>3</sup>/g STP] of 10 to 25 cm<sup>3</sup>/g STP, an oxygen content at the surface thereof of at most 5% as determined by X-ray photoelectron spectroscopy, and a specific surface area of 1,000 to 2,000 m<sup>2</sup>/g as determined by nitrogen adsorption in accordance with the BET method.

7. (Amended) The activated carbon for electric double layer capacitor according to Claim 1, wherein [the rate of FS is 10 to 25 cm<sup>3</sup>/g STP,] the oxygen content at the surface thereof is 0.1 to 4.5% [, and the specific surface area is 1,000 to 2,000 m<sup>2</sup>/g as determined by nitrogen adsorption in accordance with the BET method].

11. (Amended) An activated carbon electrode formed with an activated carbon [whose] having a rate of FS (filling swing) in an  $\alpha_s$ -plot by [the] nitrogen adsorption method [is at most 27 cm<sup>3</sup>/g STP] of 10 to 25 cm<sup>3</sup>/g STP, an oxygen content at the surface thereof of at most 5% as determined by X-ray photoelectron spectroscopy, and a specific surface area of 1,000 to 2,000 m<sup>2</sup>/g as determined by nitrogen adsorption in accordance with the BET method.

13. (Amended) An electric double layer capacitor equipped with activated carbon electrodes formed with an activated carbon[,whose rate of FS (filling swing) in an  $\alpha_s$ -plot by nitrogen adsorption method is at most 27 cm<sup>3</sup>/g STP,] as polarizable electrodes, wherein the

activated carbon has a rate of FS (filling swing) in an  $\alpha_s$ -plot by nitrogen adsorption method of 10 to 25 cm<sup>3</sup>/g STP, an oxygen content at the surface thereof of at most 5% as determined by X-ray photoelectron spectroscopy, and a specific surface area of 1,000 to 2,000 m<sup>2</sup>/g as determined by nitrogen adsorption in accordance with the BET method.

14. (Amended) The electric double layer capacitor according to Claim 13, [which is] obtained by tightly enclosing [a structure that] a separator [is held] between [2] two polarizable electrodes and further holding the resultant laminate [is further held] between [2] two collecting plates [into] in an electrolytic solution-containing case.

17. (Amended) The electric double layer capacitor according to Claim 13, which exhibits a retention of resistance of 90 to 125 % in [the] a durability test at a temperature of 70 °C and a voltage of 2.5 V for 12 hours.

18. (Amended) The electric double layer capacitor according to Claim 13, wherein both retention of electrostatic capacity and retention of resistance in [the] a durability test at a temperature of 70 °C and a voltage of 2.5 V for 12 hours are 95 to 105%.